PARTICLES IN SPACE AND TIME AT DISCONTIUOUS DIMENSIONS

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ABSTRACT
The application of the dimensional discontinuity to the coordinates of space and time, through respectively the two minimum units MIN-S and MIN-T, of finite dimensions but with no submultiples, leads to the followings results inherent to subatomic particles.
- identification of the particles dynamics.
- description of the ^{1}H atom dynamics.
- quantification of the photon mass.

References

M. Born	Einstein's Theory of Relativity
J.Andreade e Silva	Les Quanta
S. Weinberg	The discovery of Subatomic Particles
E. Parzen	Modern Probability Theory
R. Feynman	QED – The strange theory of light and matter
E. Segrè	Nucleuses and particles
R. Feynman	Six easy pieces
R. Feynman	Six not so easy pieces

0– Introduction

Particles are intended as the atom components as well as any corpuscle smaller than $(2,21).10^{-12}$ Kg, as clarified ahead.

The reading of these pages implies the knowledge of previous articles published on The General Science Journal, http://www.wbabin.net/science/serafin2.pdf , http://www.wbabin.net/science/serafin.pdf, from which the following formulas are derived, using values of 10^{-30} meters for the minimum space unity MIN-S and 10^{-38} / 3 second minutes for the minimum time unity MIN-T.

$\mathbf{Dn} = (\mathbf{n}\ \text{MIN-S}, \mathbf{n}\ \text{MIN-T})$ 0.1

$L = h / m\,(1 - \boldsymbol{v}) / \boldsymbol{v}$ 0.2

$R = L\ (1 - \boldsymbol{v}) / \boldsymbol{v}$ 0.3

$h = 3.10^{68}/1$; $h / m = (10^{22} / 3) / 1$; $e = 10^{30}/1$; $f = 1 / 3.10^{38}$; $m = 9.10^{46}/1$; $a = 1/ 9.10^{46}$. 0.4

$\mathbf{v} = L\ \text{MIN-S} / (L + R)\ \text{MIN-T}$ 0.5

$m = m° . 1 / R = m° . \{ (m° / h) . [\mathbf{v} / (1 - \mathbf{v})]^2\}$ 0.6

$e = (m° \mathbf{v}^2 / 2). \{(m° / h) . [\mathbf{v} / (1 - \mathbf{v})]^2\} = h / 2. [1 / (L + R)^2]$ (See note at page 10) 0.7

$m = e / (\mathbf{Vd})^2$ 0.8

Vd, dyadic speed, is the quotient MIN-S / MIN-T equal to 3.10^8 m/sec verified for all dyads.
Vs is the speed that, for a determined mass, makes unitary the parameter R of the formula 0.3.
Vt is the speed that determines, for an assigned mass, the kinetic energy of 10^{-19} Joule (0,6 eV) and establishes a parameter R equal to 10^{24} MIN-T.
The meaning of the aforementioned formulas will be specified ahead.

1 – Particles

The special feature which makes electrons, protons and neutrons ever-present ingredients of matter is their stability; electrons are considered absolutely stable, protons and neutrons live at least 10^{30} years inside the nucleus, whereas the free neutron decays into a proton and an electron in the time of approximately fifteen prime minutes.

With few exceptions, all the other particles are unstable and have a very brief life. For this reason they are very rarely observed in normal physics laboratories, whereas they can be observed in experiments carried out using great accelerators installed in nuclear research centres.

The electron was the first elementary particle to be clearly identified. It is also the lightest particle by far and one of the few which does not decay into other particles.

Because of its stability, its lightness and its electric charge, the electron has primary importance in Chemistry, Physics and Biology. Every atom of the universe is made up of a dense core (nucleus) surrounded by a cloud of electrons and the chemical differences between one element and another depend almost exclusively on the number of electrons in the atom.

Other particles from the same category are the muon and the tauon, both unstable and with an average life of a few millionths of a second.

All particles admit a specific antiparticle with the same mass but opposite electric charges, and with similar physical magnitude. Thus the electron corresponds to the positron, theorised by the theoretical Physics scholar Paul Dirac during his mathematical processes from which he surprisingly obtained solutions with negative energy.

The family of particles is now so large that it contains hundreds of elements and it is expected that recent discoveries concerning quark will offer further opportunities to identify other components of matter. Particles have such minute dimensions and feature such accentuated mobility that they are invisible to even the most sophisticated microscope systems. Their presence can be observed almost exclusively by the kinetic energy they transmit to a contrast device. It is therefore important to know how this energy is linked to the motion of particles themselves and the following lines will illustrate the concepts of dyadic dynamics applied to the correlations between particle masses and dynamic levels they can adopt.

The underlying diagram AA uses Cartesian co-ordinates to show the two principal parameters connected to dyadic dynamics of light masses, which are made up of the following quotients: **h** / ***m*,** where h is the Planck constant and *m* the mass, calculated in MIN units and **(1 – v)** / **v** , calculated using velocities in ratio to Vd.

The centre of the co-ordinates refers to a mass of around 2.21 .10^{-12} Kg and to a speed equal to half that of **Vd**, both within the null power of ten of the quotients cited above. The positive ordinate is dedicated to masses with **h** / **m** > 1, while the negative abscissa corresponds to high velocities above **Vd** / 2.

The diagram contains the line **Vt**, shown as a dotted line, and the continuous line **Vs.** These lines delineate three areas: Area 1 to the left of the continuous line, Area 3 on the right of **Vt** and Area 2 between the two lines. These areas refer to different calculation modes regarding both velocity and quantification of kinetic energy.

The line **Vt** is the set of points where the kinetic energy for each mass corresponds to around 10^{-19} Joule (0.6 eV), and for which the parameter R is established equal to 10^{24} MIN-T, corresponding to less than a hundredth of a billionth of a minute second, the stopping time that can be developed in the kinetic intermittences and which is to be considered as the maximum value. Therefore Area 3 is a field that excludes the quantification of velocities, for which the motions can only take on the role of casual magnitudes of Brownian type.

The area 1 is confined on the left of **Vs,** which entails all points governed by the equality
(1 – v) / v = (***m*** / **h**)$^{1/2}$, equivalent for 0.3 to R = 1.

Within all Area 1, the formulae 0.6 and 0.7 are valid, for which mass and kinetic energy undergo an exponential increase correlated to the necessity to render the parameter R as a unitary value, a method which arises to avoid sub-multiples of MIN-T, as explained on the above mentioned articles.

The Area 2, delimited by the continuous line and the line **Vt**, features values for R always greater than the unit and always greater than L, that is an area where the classical formula of the kinetic energy is valid.
At this point some explanations are necessary to reassure the reader faced with quite divergent results from the normal notions of mechanics, both classic and relativistic.

A justification must be given for the following two aspects:
A – For all masses the kinetic intermittences of movements must carry out a single maximum temporal extension of the parameter R equal to 10^{24} MIN-T .

B – All masses are subject to the increases of formulas 0.6 and 0.7 if they carry out velocities inherent to Area 1.

For the A aspect, a valid example would be the winding mechanism of cinema film, which uses a time of arrest between two frames which is chosen so that the viewer perceives them as a single animated scene.
This time of arrest is the maximum value beyond which the projection would fall into a discontinuous succession of static scenes, each lasting a very short time.

This behaviour is similar to the kinetic intermittences found in dyads: the parameter R has the same function as the time of arrest explained above and, in the same manner, it cannot exceed a fixed value without breaking down the intermittences themselves. The maximum threshold for R has been chosen by approximation as 10^{24} MIN-T, but this value needs to be verified by suitable experimentation.

The B aspect is the furthest removed from normal concepts of mechanics and is directly derived by the need to avoid inadmissible sub-multiples of MIN-T, or rather to exclude the possibility of a smaller open interval within the same MIN-T.

2 - Dynamics of particles
Included in diagram AA are the kinetic configurations of particles distinguished on the positive ordinate by different values of **h** / ***m***, such as the electron, the muon, the proton and the tauon.

For the electron, all the velocities that can be developed are represented by the highest dotted line on the diagram, starting horizontally from point (e) until it crosses the continuous line **Vs** and then bends around 63° towards the negative abscissa until it reaches it at the point where its L parameter becomes unitary and for 0.2 the equality **(1 – v) / v** = ***m*** / **h** is established.

At its intersection with **Vt**, this dotted line shows the minimum velocity of a free electron, while for the whole horizontal segment to the right of **Vs** its mass moderately increases by the formula 0.8 and its kinetic energy is quantified by the classic formula $e = (m\,\mathbf{v}^2 / 2)$. Alternately, the oblique segment to the left of **Vs** shows the effect of an exponential mass and energy increase, in accordance with formulas 0.6 and 0.7.

The situation described for the electron is repeated for the other three particles which have velocities shown by the horizontal dotted lines departing from (□), (p) and (□) referring respectively to the muon, proton and tauon, in decreasing order of **h** / ***m***. Obviously, each particle manifests its own kinetic characteristics in the various intersection points with the lines **Vt** and **Vs**, all having the minimal energy of 0,6 eV at the point of **Vt**.

Table below gives the main data inherent to the four particles stated above, by line and column, where v**(Vt)**, velocity in correspondence with the line **Vt**, is quantified in Km/sec, whereas v**(Vs)**, speed in correspondence with the line **Vs**, is expressed in ratio to the dyadic velocity considered as unitary. These velocities are calculated using formula 0.5 applying, at the respective values of **h** / **m**, the parameters L deduced from the formulae 0.2 and 0.3 for R = 10^{24} MIN-T and R = 1 MIN-T.

The kinetic energies *e***(Vt)**, *e*(**Vs**) are quantified in eV, whereas the **h** / **m** quotient is expressed in MIN units, that is with the SI (m,sec) value multiplied for (10^{22}/3); factor drawn by second formula of 0.4.

TABLE OF DYNAMIC VALUES

	e	μ	p	τ
m (Kg)	$0{,}91 .10^{-30}$	$1{,}88 .10^{-28}$	$1{,}67 .10^{-27}$	$3{,}21 .10^{-27}$
h / ***m***	$2{,}42 .10^{18}$	$1{,}17 .10^{16}$	$1{,}32 .10^{15}$	$0{,}69 .10^{15}$
v(**Vt**)	466	32,6	10,9	7,9
e(**Vt**)	0,6 eV	0,6 eV	0,6 eV	0,6 eV
v(**Vs**)	$\frac{1{,}55 .10^9}{1{,}55 .10^9 + 1}$	$\frac{1{,}08 .10^8}{1{,}08 .10^8 + 1}$	$\frac{3{,}6 .10^7}{3{,}6 .10^7 + 1}$	$\frac{2{,}63 .10^7}{2{,}63 .10^7 + 1}$
e(**Vs**)	0,26 MeV	54,5 MeV	470 MeV	926 MeV

3 - Correlations between particles
The dynamics discussed in the previous chapter allow us to highlight symmetric quantities of kinetic energy which illustrate the existence of profound correlations between the four particles described above.

Let us describe an example revealing the link between the electron and the muon. In diagram AA the horizontal dotted line of the muon is extended in a continuous line until it meets the oblique bent line of the electron at point (μ*). In this way an isosceles triangle is formed on the graph with base equal to height, and in logarithmic scale the latter comes from the quotient between the two values of **h** / ***m*** respectively referring to the muon and the electron.

Furthermore, using the table above, the value of the muon expressed as **(1– v)** / **v** can easily be obtained from its v**(Vs),** which is equal to $0,92\ .10^{-8}$. This value, multiplied by the quotient above, gives the value **(1 – v)** / **v** of the point (μ*), which is equal to $0,44\ .10^{-10}$.

Bearing in mind that the image is in logarithmic scale, the calculation is as follows:

$(1,17\ .10^{16} / 2,42\ .10^{18})\ .\ 0,92\ .10^{-8} = 0,44\ .10^{-10}$.

Applying the formulae 0.2 and 0.3 to the same point (μ*), referring to the mass of the electron, we obtain the proper values of L and R; which are $L = 1,06\ .10^{8}$ and $R = 0,46\ .10^{-2}$, results for which the kinetic energy increased by 1 / R and expressed by the second part of the formula 0.7 in SI units, is quantified by the following calculation:

$e^* = [(3\ .6,63\ .10^{34}) / 2]\ .\ [1 / (1,06\ .10^{8} + 0,46\ .10^{-2})^2]\ .10^{-30} = 8,8\ .10^{-12}$ Joule; which are equivalent to 54,5 MeV.

This energy value, if some rounding of figures is disregarded, coincides surprisingly with the muon's *e***(Vs)** of 54 MeV, representing an energetic parity which has also been completely confirmed by experiments.

The meaning of this parity can be stated briefly. If the kinetic energy of the point (□*), referring to the electron, and the *e***(Vs)** of the muon coincide, this means that in such situations the two particles show an equal **h**/**m** quotient, and for this reason they become perfectly interchangeable entities. Therefore an electron at 54 MeV is equal to a muon stressed to the line **Vs**, and vice versa, at least for the brief lifetime duration of the latter.

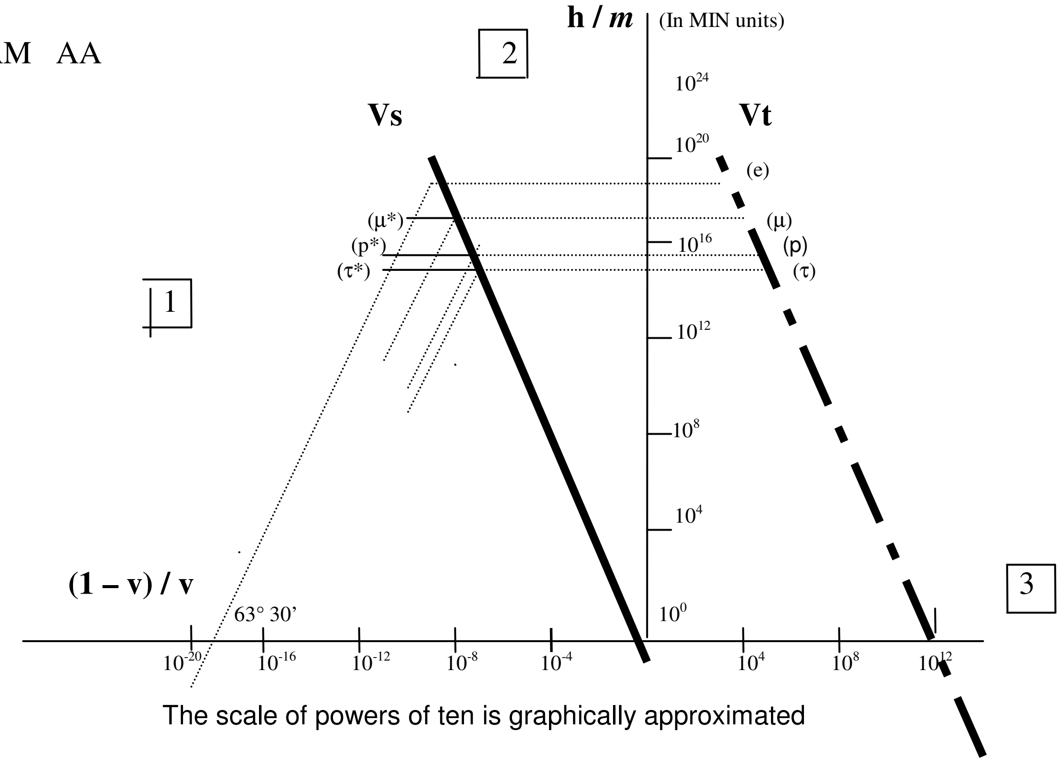
By enlarging similar considerations regarding the points (p*) and (τ*) on the oblique line of the electron, it is shown that the electron takes on energies close to 470 MeV and 926 MeV respectively which are typical of the proton and the tauon brought to the respective levels of *e***(Vs)**. Therefore the electron itself is liable to convert itself into even a negative proton, that is an antiproton, or into a tauon.

It is interesting to note that although diagram AA shows a noticeable interval between the v(**Vs**) of the electron and its velocity at the point (μ*), in reality, their effective difference calculated using formula 0.5 determines a spatial discordance minor than one micron over a distance of $3\ .10^{8}$ metres. That is, the substantial energy increase from 0,26 MeV to 54 MeV depends on a insignificant disparity in the paths that may be carried out in one second at the velocities stated above.

Likewise, also the other particles experience extremely small differences. The reader must not forget that particles can be revealed under experimental conditions only if they create moving pairs, performed according to a precise spatial-temporal scan and able to transmit their kinetic energy to a common point through impact. From this condition we can deduce that the correlations described above become experimentally observable phenomena only when they occur in very large numbers,

Moreover, it is worth noting that, based on the previous table of the dynamic values, the v(**Vs**) of the electron is equal to approximately $1,55\ .10^{9} / (1,55\ .10^{9} + 1)$ compared to the dyadic velocity, so that the exponential increase of its mass and kinetic energy begins only to a speed very closed to **Vd**.

DIAGRAM AA



The scale of powers of ten is graphically approximated

4 - The dynamics of the hydrogen atom

There are three different types of hydrogen atoms. Each of these has a single proton in the nucleus and consequently a single orbiting electron. However, two types of hydrogen have one or two neutrons respectively in addition to the proton.

Almost all the hydrogen atoms found on Earth, 99,986 per cent to be exact, are made up exclusively of a proton around which one electron orbits, and this pair is identified as ^{1}H. The tiny remainder (0.014 per cent) of natural hydrogen atoms contain a neutron in addition to a proton in the nucleus. This percentage concerns the so-called heavy hydrogen known as deuterium and identified as ^{2}H. The third type of hydrogen identified as ^{3}H, has two neutrons in the nucleus, and is called tritium. It does not occur in nature but is only produced artificially in nuclear plants and decays immediately as it emits ionising radiation.

In the interpretation made by N. Bohr the possible trajectories of the single electron belonging to the hydrogen atom are carried out exclusively on quantized circumferences, which correspond to the energies of spectral terms in the formula by J.J. Balmer.

As early as the end of the nineteenth century, this scientist led to the determination of the following formula supplying all the spectral frequencies of hydrogen.

$$f = R_y c [(1 / 2^2) - (1 / n^2)] \qquad 4.1$$

where c represents the velocity of light and R_y represents the constant by J.Rydberg, equal to $1,09737312 .10^7$ m^{-1} , and n stands for the successive numbers 3, 4, 5…

Basing his ideas on formula 4.1, the inspired step taken by Bohr was to attribute exclusive levels of energy to the trajectories of the electrons. With these levels of energy, during the passage from one to the other, each quantum leap is exactly equal to the energy of a photon expressed in the relation by Planck *e* = h *f* where *f* stands for frequency in Hz.

The spectrum of hydrogen limited to visible frequencies calculated according to formula 4.1 gives results made up of the radiations indicated in table below:

TABLE OF RADIATIONS

Radiation	n	frequency	wavelength	energy (eV)	colour

Hα	3	$0{,}456 \cdot 10^{15}$	$6{,}58 \cdot 10^{-7}$	1,8	red
Hβ	4	$0{,}616 \cdot 10^{15}$	$4{,}86 \cdot 10^{-7}$	2,5	green-blue
Hχ	5	$0.690 \cdot 10^{15}$	$4{,}34 \cdot 10^{-7}$	2,85	blue
Hδ	6	$0{,}723 \cdot 10^{15}$	$4{,}15 \cdot 10^{-7}$	2,99	violet
Hε	7	$0{,}755 \cdot 10^{15}$	$3{,}97 \cdot 10^{-7}$	3,12	(ultra)violet

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In the decade that followed the publications of Bohr's fundamental annotations, his theory became known and considerably perfected, and his predictions continued to be proven correct. So the expounders of theoretical physics embarked upon an interpretation of atomic spectra which became more and more complex and their calculations became approximate and the exactitude of the theoretical predictions was slightly compromised. However, the theory responded conveniently and the physicists took their first steps into the complexity of spectral lines.

It was seen that these lines, which had been calculated so exactly by Bohr, often separated into different very close components, and thus the idea of fine structure started to be discussed.

5 - The dyadic version of Balmer's formula

The spectrum of any element is the set of specific frequencies of light which can be emitted or absorbed by the atoms of that element. For example, when a compound containing a given element is added to a flame and the light of the flame is split into its component colours by means of a prism or a diffraction net, we find that the band of colours is streaked with a fixed number of luminous lines of particular colours corresponding to the frequencies of the light emitted by the atoms of that element.

But how are these electromagnetic radiations generated or absorbed, for example those we can see with the naked eye and that we call light? The cause of visible light is not the atom as a whole, but its electrons. If heat is applied to a material, above a certain temperature it emits luminous waves, which takes place because its electrons modify their energy state abruptly. In other words, when the temperature increases, a large quantity of electrons passes from a relatively low energy state to a higher one, absorbing part of the thermal energy received from outside. However, the electron tends to revert to its normal state by returning the energy it has received in the form of light with very precise frequencies. That is, as soon as possible it releases the energy which has been supplied from the outside by generating photons, or an electromagnetic emission.

Whichever way the visible light is produced, it is always a fall of energy by the electrons inside an atom.
At this point we can refer to the universal principle of energy conservation, through which we can understand that there must be a perfect balance between the kinetic energy of the electron and the electromagnetic energy irradiated by it through its photons.

In practice, it becomes clear that at the moment the electron emits electromagnetic waves, it is subject to a compensatory deceleration, which is a loss of kinetic energy to the total benefit of radiant energy.
Under this hypothesis of energy balance, let us now imagine we must calculate the deceleration involving the electron for these mechanics.

Let us now observe Balmer's formula, made up of two distinct terms placed inside square brackets 4,1 and represented by number 2, constant for all radiations, and by the successive numbers 3. 4, 5, each typical of one radiation. This algebraic formula can be understood as the presence of deceleration modules which operate inside the parameter L of the unique electron of hydrogen atom ^1H. In other words, the deceleration is obtained with the addition of a precise quantity of MIN-T "stops", exactly every two MIN-S "steps" inside the same L, according to the frequency of the radiation and to the special atomic structure of hydrogen.

The increase of R, necessary to establish a lower electron velocity as stated in formula 0.3, takes place during the course of the parameter L itself, in accordance with the discrete quantities specified by the deceleration modules in the table below.

TABLE OF DECELERATION MODULES

Radiation	n	module	MIN-S "steps"	MIN-T "stops"
Hα	3	>>0	2	1

Hβ	4	>>00	2	2
Hχ	5	>>000	2	3
Hδ	6	>>0000	2	4
Hε	7	>>00000	2	5

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(the symbol > stands for a MIN-S "step" and the symbol 0 stands for a MIN-S "stop")

The modules clearly express the discontinuous structure of space and time provided by dyads and force the electron to acquire discreet deceleration values, i.e. to emit radiations with frequency and energy which feature equally discreet levels.

When Balmer's formula is completed with Planck's it becomes:

$$h R_y c [(1 / 2^2) - (1 / n^2)] = h f \qquad 5.1$$

which shows that its component $h R_y c$ is dimensionally equal to an energy. In fact, when we pass to the relative measurement units, it becomes:

$$h R_y c = J t \;.\; 1 / s \;.\; s / t = J \qquad 5.2$$

where s stands for metre, t for second and J for Joule.

The electromagnetic energy of the electron is therefore quantized by the terms within square brackets of formula 5.1, i.e. by the deceleration modules given above.

Every deceleration module, which represents a typical way of reducing the kinetic energy of an electron, directly works proportionally to the factor $1 / (L + R)^2$ according to the formula 0.7. In practice, every module reduces the energy through two essential conditions: the first through the constant presence of two MIN-S "steps" and the second through the union of MIN-T "stops" with such two MIN-S.

Based on the said factor $1 / (L + R)^2$, the first condition provides the value of $1 / (2\ \text{MIN-S} + 0)^2$, equal to $1 / 2^2$, while the second achieves the value of $1 / (2\ \text{MIN-S} + \text{"stops" MIN-T})^2$ equal to $1 / n^2$. It is evident that their arithmetic difference, which is proportional to the reduction of kinetic energy of the electron, becomes the term $[(1 / 2^2) - (1 / n^2)]$ contained in the 5.1. In conclusion such term, when changing n, traces the quantized electromagnetic energy represented by the formula of Balmer.

It should be noted that the two aforementioned conditions, although apparently separated, act in synchrony because the first represents the speed **Vd** suitable to the parameter L, while the second is the direct function of proportionality in the deceleration of the electron. In practice, these two conditions constitute the loss of kinetic energy of the electron because the classic formula of deceleration cannot be applied to the sudden variations of velocity that the electron undergoes inside the atom.

As is known, the classical formula is made up of an arithmetic quotient between the difference in velocity and the time in which it takes place, but in the case of the electron, a difference in velocity can obviously not be expressed analytically within its own L parameter. At this point, we could put forward the idea that radiations emitted by the electron do not occur from single deceleration module, but occur from the joint participation of low quantities of various modules of the previous table in each sequence L. The ensuing result is the emission of closely-positioned bands of radiation with very close frequencies in the place of those calculated by Balmer's formula. This arrangement is able to generate the appearance of the different adjacent lines, as described in the fine structure version given above.

6 - Photon mass

There are strong affinities between particles and photons, relating to the way in which they transmit energy to an obstacle they meet along their travelling direction. Both must make pairs in order to express a precise spatial-temporal scan between the two formation elements, which must also be identical (for mass in the case of identical particles and in the case of photons, with an identical displacement angle).

It must be remembered that within the sinusoidal type of electromagnetic wavelength every MIN-S segment, and therefore every possible photon within it, corresponds to a specific displacement angle which can be represented for every MIN-S by the position taken by an equivalent rotating vector. In practice, the particles suitable for transmitting energy by collision must be arranged in pairs of elements separated from each other by the formulae 0.2 and 0.3 and the photons must belong to two adjacent sinusoidal electromagnetic waves, one for each photon, of a single straight line of propagation so that for each pair they create a scan equal to the wavelength, i.e. equal to an exact round angle.

The fact that particles and photons can transfer energy only if they are arranged in pairs depends on their extremely reduced spatial dimensions in relation respectively to L segments or to wavelengths, entities which are the unique and complete reference points of the pairs' energies, be they kinetic or electromagnetic.
It is necessary to remember that the length λ and the period T of an electromagnetic wave are intervals which feature perfect equality in the number of MIN-S and MIN-T elements, that is they transport a dyad of the type shown from formula 0.1. Therefore dyads and waves are dimensionally the same sampling of space and time and it is in the recognition of this reciprocal equivalence that the main new concept can be seen.

The new idea is as follows: every dyad represents the different entities of physical reality according to physical quantifications which stem from its exclusive measurement units, quantifications which therefore give different results to those expressed by other dyads. In the same way, an electromagnetic wave leads to a quantification of the phenomenon of radiation exclusively in function of its own spatial-temporal parameters, i.e. in function of the measurement units, respectively of space and time, given by λ and the period T. As in dyads, radiant energy and mass increase as the wavelength reduces and decrease as it expands. Concerning the electromagnetic energy of a pair of photons, since its variation is inversely proportional to the wavelength, or to the spatial component of the equivalent dyad, it is directly established by Planck's formula given below:

$$e = h f = h / T = h / \lambda \qquad 6.1$$

where λ is quantitatively equated in MIN-S units to the period T , expressed in an equal number of MIN-T, exactly as occurs for every dyad.

Concerning the mass of a pair of photons, as known from the above cited articles, it is necessary to return to fossil radiation which features an unitary R value, i.e. equal to the number 1, and an L value established by its wavelength of 7.35 cm; in this way from the expression $m = h / L . R / L = h . R / L^2$, given from formula 0.3, with the equality **(1 – v) / v** = R / L , we obtain the relation below:

$$m = h / L^2 \qquad 6.2$$

The calculation of 6.2 in MIN units, referring to a pair of photons of fossil radiation in particular, is as follows:

$$m = (3 .6,63 .10^{34}) / (7,35 .10^{-2} .10^{30})^2 = [(3 .6,63 / (7,35)^2] .10^{-22} \qquad 6.3$$

where the numerator is represented by the h value and the denominator by the fossil wavelength λ_f, equal to 7.35 centimetres, both quantified in MIN units.

Based on formula 6.3 we can work out the **h / *m*** value, again in MIN units, using the following formula:

$$\mathbf{h} / \boldsymbol{m} = 3 .6,63 .10^{34} / [3 . 6,63 / (7,35)^2] .10^{-22} = (7,35)^2 .10^{56} \qquad 6.4$$

Let us now consider the diagram BB, which is an extension of diagram AA. The dotted line (a) departs from the point on the positive ordinate equal to the value 6,4 and crosses the line **Vs** at point C, indicating exactly the dynamic condition of the photon of fossil radiation. As was said above, in fact it features a unitary R and an L of $(7.35 .10^{-2} .10^{30})$ MIN-S, parameters which express the abscissa value equal to $(7.35 .10^{-28})$, corresponding, for the formula 0.5 to the following velocity:

$$\mathbf{v} = (7.35 .10^{28}) / [(7.35 .10^{28}) + 1] \qquad 6.5$$

in ratio to dyadic speed.

Along segment CA, from the top to the bottom, the wavelength decreases below 7.35 centimetres and the mass increases. In fact the **h / *m*** quotients decrease on the positive ordinate while velocity increases, as a function of the negative powers of ten indicated in the abscissa. Now it is necessary to verify how far the CA segment is a valid representation of physical reality. As was already seen in the article cited above, when the calculation of the extension of parameter R brings about its reduction to below the unitary value, a fact which would seem to be in contrast with the postulate of the indivisibility of the MIN-T magnitude, the dyadic dynamic must necessarily abandon the minimal dyad (1 MIN-S, 1 MIN-T) and use a new suitably extended dyad, able to preserve the integrity of the MIN-T magnitude.

By observing diagram BB, we deduce that the parameter R reduces with greater velocities of 6.5 and therefore this reduction must be balanced by an increase in the minimal dyad of the dyadic scale. However, this increase can take place only as long as there is an equality between the increasing spatial unit of the said dyad and the electromagnetic wavelength as it decrease. In practice, this equality is created half way between $\lambda = 1$ Min-S and $\lambda = 7.35\ 10^{28}$ MIN-S, equal to a wavelength of $(7.35\ 10^{28})^{1/2}$ MIN-S, i.e. at the minimum $\lambda_m = (7.35)^{1/2}\ .10^{-16}$ metres. The wavelength above corresponds to the following frequency:

$$f = [3\ .10^{8} / (7,35)^{1/2}]\ .10^{-16} = [3 / (7,35)^{1/2}]\ .10^{24} \quad \text{Hz} \qquad 6.6$$

typical of gamma rays emitted by synchrotrons, as well as being the upper limit of electromagnetic waves
At this point it can only be acknowledged that the discontinuous structure of space and time shown through MIN-S and MIN-T units attains, in its formulation of the above value of maximum frequency in agreement with experimental data, a validity which cannot be disregarded when treating the problems of Physics.
Based on triangle ABC, of equal base and height and logarithmic scale coordinates, the above quoted photon of maximum frequency assumes an **h** / ***m*** equal to $(\lambda_m / \lambda_f)^2\ (7,35)^2.10^{56} = (7,35)\ .10^{28}$ that verifies, for 6.2, the following value of mass in MIN units:

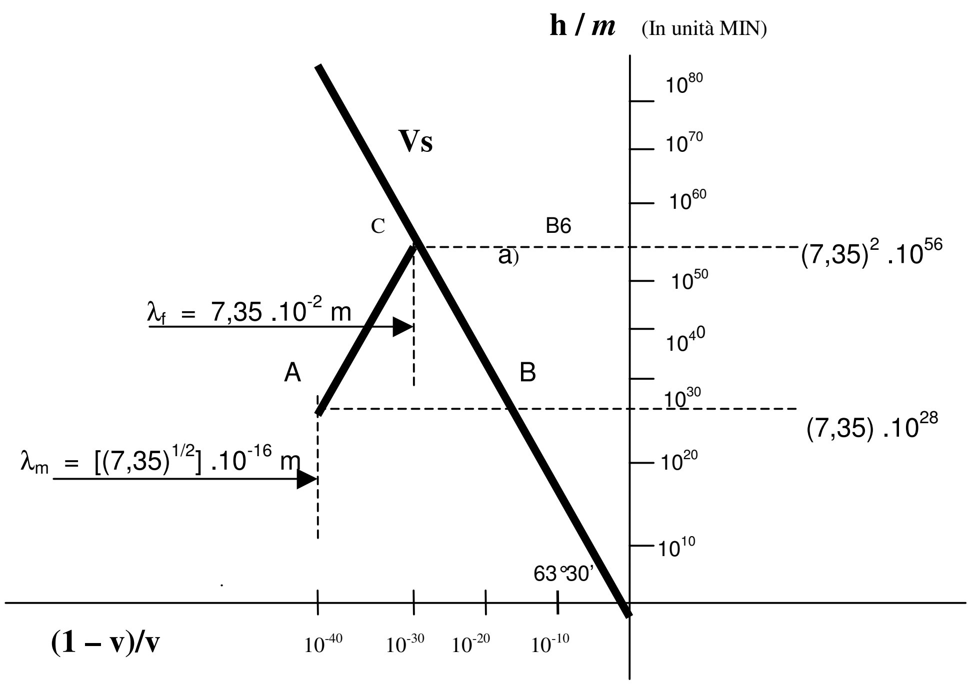
$$m = 3\ .6,63\ .10^{34} / (7,35)\ .10^{28} = [3\ .6,63 / 7,35]\ .10^{6} \qquad 6.7$$

With reference to the SI system (meter, second), the quantities derived from 6.3 and 6.7 bring to the following values:

$m = [(3\ .6,63 / (7,35)^2]\ .10^{-22} / 9.10^{46} = [.6,63 / 3.\ (7,35)^2]\ 10^{-68}$ Kg (Pertinent to the fossil radiation)
$m = [3\ .6,63 / 7,35].10^{6}\ / 9.10^{46} = (3\ .6,63 / 7,35)\ 10^{-40}$ Kg (Pertinent to the gamma radiation)

which are to be consider the lowest and the greatest photon mass.

DIAGRAM BB



The scale of powers of ten is graphically approximated

Note: the second part of formula 0.7, which appears in the Introduction, or $h / 2. [1 / (L + R)^2]$, originates from the classical formula of the kinetic energy. The expression $m = h / L.\ R / L = h. R / L^2$ is applied to such classical formula in the calculation of 6.2. We then obtain the following:

$e = (m / 2). \mathbf{v^2} = h / 2. (R / L^2). [L^2 / (L + R)^2] = h / 2. [R / (L + R)^2]$

that, in the case of the speed **Vs,** increases by the inverse of R and becomes exactly the one mentioned above.